TLM

June 23, 1981

American Research and Development
and
53rd Street Ventures, Inc.
and
Excelsior Fund
and
Memorial Drive Trust

The attached is a true and correct copy of the Business Plan of Symbolics dated June 22, 1981.

John L. Kulp, Jr. Secretary	Russell Noftsker President

TLM

June 22, 1981

BUSINESS PLAN
of
SYMBOLICS, INC.
(A Delaware Corporation)

Symbolics, Inc. is in the business of developing, manufacturing and selling high performance computer systems initially targeted for the Artificial Intelligence research market and ultimately planned to be sold into the CAD and commercial business turnkey applications markets.

The product line being commercialized is starting with the introduction of a computer system (the "A" machine) in June 1981 which is a production engineered version of the MIT Lisp machine. The next three hardware products are improved price/performance versions of the first product intended to expand sales volume and broaden the product line as well as improve margins.

The first of these new systems (the "L" machine) is under development now and is targeted for commercial introduction during the first quarter of calendar 1982. It's price will be approximately one half and its performance at least three times that of the current "A" machine product.

The second new system (the "I" machine) to be developed and introduced around July 1983, will be a low cost (approximately $30,000 price) VLSI implementation of a system capable of running the operating system and applications software developed on both earlier models. The last currently planned hardware product to be developed and introduced around December 1983, will be a high performance system having approximately five times the performance of the "L" machine and selling for approximately $350,000.

The forth product planned to be developed is a VLSI CAD program intended to be sold for operation on the final three above systems. As a test to debug the VLSI CAD product, it will be used to develop the above "I" machine. The VLSI CAD product is expected to be introduced during the summer of 1982 if development funding is obtained in time to support this schedule.

Symbolics'management headquarters and R&D activities are currently located at 257 Vassar Street in Cambridge, Massachusetts. Manufacturing, marketing and finance are located at 21150 Califa St. in Woodland Hills, California.

It is the present intention of management to include the offices of finance and marketing with management within facilities reasonably close to the present Cambridge office.

Manufacturing may be relocated from Woodland Hills, CA depending upon a determination by management and the directors of the need for and feasibility of doing so, and selection of a location more convenient to the above centralization of management. The issue of relocating manufacturing will be resolved before any major "L" machine production commitments are made by Symbolics. Woodland Hills facilities commitments and staffing will be held to the minimum compatible with completion of "A" machine production and with preserving the maximum flexibility to relocate activities underway there.

Relocation and consolidation implementation details will be worked out and implemented as reasonably determined by management and the directors during calendar 1981.

The following sections discuss the Company, its plans and its founders.

SECTION 1

1.1 INTRODUCTION

Symbolics, Inc. (the "Company" or "Symbolics") was formed on April 9, 1980 to engage in the design, manufacture and sale of advanced state-of-the-art, high performance, single-user computer systems featuring a highly interactive man/machine interface. These systems were designed in response to the growing demand for increasing the productivity of highly skilled professional staff in various high technology disciplines (see "THE COMPANY'S PRODUCTS"). Present applications include the design of very large scale integrated ("VLSI") circuits, symbolic mathematical analysis, genetic engineering, seismic studies for oil and mineral exploration, software production and artificial intelligence research and development (see "MARKETS"). The system design objective, achieved to an extent never before offered commercially, has been to enhance greatly programmer and user productivity.

The Company brings together most of the very high caliber team who designed and produced the Massachusetts Institute of Technology ("MIT") LISP computer series and its operating system. These same authors also created much of the applications software which runs on that computer (see "MANAGEMENT AND KEY EMPLOYEES"). The Company believes that this team will enable the Company to remain at the forefront of future technological developments in both hardware and software.

1.2 THE COMPANY

Symbolics, Inc. (the "Company") is a newly-organized

Delaware corporation formed to develop and market computer hardware and software designed specifically to optimize programmer productivity in areas of complex computer applications such as design of very large scale integrated ("VLSI") circuits, symbolic mathematical analysis, genetic engineering, seismic studies for oil and mineral exploration, software production and artificial intelligence research and development. Since its formation on April 9, 1980 by Robert P. Adams and Russell Noftsker, the Company's activities have consisted of organizational efforts, the acquisition from the Massachusetts Institute of Technology ("MIT") of rights to certain software, and the introduction of the Company's first product and the design of its first volume product.

The production facility of the Company is at 21150 Califa Street, Woodland Hills, California 91367 (213-347-9224) and Research and Development facility is at 257 Vassar Street, Cambridge, Massachusetts 02139 (617-864-4660).

and headquarters

1.7 BUSINESS PLAN - INTRODUCTION

The projected sales and earnings for the six fiscal years ended March 31, 1981 through March 31, 1986 are summarized below. A detailed set of projections together with the assumptions thereto are set out in Appendix A. The projections have been prepared by management in good faith on the basis of information available to them. The assumptions set forth are an integral part of the projections and must be considered in reading the projections. No assurances can be given that the Company will actually attain the level of operations or profitability projected.

SUMMARY

(See Appendix A For Full Detail)

SECTION 2

2.1 MARKETS

Overview

LISP is generally regarded as the best language for the development of software which employs artificial intelligence techniques (see "SYMBOLIC COMPUTING") and the Company regards its computers as being the most efficient and cost effective for the implementation of the LISP language.

Outside the field of artificial intelligence research, computer software has been, and continues to be, developed for a number of application areas, most of which require the use of artificial intelligence techniques. These developments have primarily been aimed at providing valuable aids to professionals such as engineers, scientists and doctors. These "professional support" or "expert" systems assist professionals by delivering detailed knowledge, techniques, and tools in an interactive usable form. Practical examples include systems for the design of VLSI circuits, symbolic mathematics systems, medical advisory systems, biochemical analysis systems and systems for the planning of molecular genetic experiments. Since professional support systems can dramatically increase the productivity of their users, the scope of the market for such systems is considerable.

A distinguishing feature of professional support systems is the need to support many computational activities in a single, integrated environment. These systems are software intensive, composed of tens of thousands of program instructions. Their implementation requires more powerful software development tools than those previously available. Symbolics will provide hardware and software which gives superior performance for these systems at a reasonable price.

Very Large Scale Integrated ("VLSI") Circuit Design

In recent years the technology for the manufacture of integrated circuits has advanced very rapidly. It is forecast that within the 1980's, new technologies will permit the cost-effective manufacture of IC's with a complexity equivalent to between 100,000 and 1,000,000 transistors. This level of complexity will permit the creation of single-chip digital systems comparable in complexity to a present day large computer. In contrast to the rapid evolution of IC manufacturing technologies, the techniques and tools for the design of IC's have progressed relatively slowly. Much of this design work is still carried out manually. With current commercial techniques it would require several man-years to design a custom VLSI chip with a 100,000 transistor complexity.

A high design expense is cost-effective when it can be amortized over large production volumes, as is usually expected for memory and microcomputer designs. Large scale integrated ("LSI") circuits and VLSI circuit chips are collectively cheaper to produce, more reliable, smaller, often faster and require less power than circuits produced using a lower level of integration.

Those products requiring electronic logic, such as electronic games or automobile ignition systems, which are not produced in such quantities as would warrant the custom design of an LSI or VLSI chip, have two principal alternatives. First, the electronics can be manufactured using a lower level of integration, where a number of discrete semiconductor devices and/or small scale integrated circuits are connected by way of one or more PCB's. The design costs of such logic are relatively low, but the manufacturing costs are relatively high. Secondly, a mass-produced microprocessor can be used with software being developed for that particular application. The software development cost of this approach are likely to be relatively high, while the costs of purchasing the chips will be relatively low. Because the logic in such a system is controlled by computer software, it will operate at a substantially slower speed than the integrated method where the logic is in the hardware. The ideal approach would be to have a VLSI design system which would reduce the VLSI design cost to a level comparable to that required for microprocessor software development, that would make possible the use of low cost custom VLSI chips.

Much of the state-of-the-art work on software for VLSI design systems is being carried out at universities. The Company plans to provide the bridge between these development centers and industry and to put together various software packages into a single comprehensive system covering all aspects of VLSI design.

Management estimates that such a system will reduce the time taken to design a 40,000 transistor chip from the current industry practice of 2 to 10 man-years (including layout) to approximately three man-months. Affiliations involving the sharing of software developments are being set up by the Company with selected universities and IC manufacturers in order to create the means for collecting and putting together some of the more significant VLSI design software developments presently being pursued, although no such agreements have yet been reached.

The Company will concentrate on the custom design end of the VLSI market. For very high volume chips, manufacturers are prepared to pay a premium price in order to achieve design optimization with the maximum number of elements crammed on the smallest possible size of silicon chip, in order to minimize manufacturing costs. Custom chips can tolerate less area efficient designs more readily, because even a relatively inefficient custom chip is still likely to be substantially more cost-effective than its PCB counterpart. As a result, Symbolics

will focus on reliability and design productivity rather than silicon minimization.

Artificial Intelligence

There are currently about fifty university, government and industrial laboratories carrying out research in artificial intelligence ("AI"), and which employ approximately 2,500 professional scientists, the majority of whom require regular access to large amounts of symbolic computation. University research computer expenditures are expected to increase substantially over the next three to five years as a result of a National Science Foundation study recommending the spending of $100 million to upgrade the computing facilities of these laboratories. Industrial research laboratory use of symbolic computing is also expected to grow rapidly because of increased interest in general office automation and the need to enhance professional and manufacturing productivity through the application of artificial intelligence and robotics techniques.

The Japanese government is reportedly funding a $100 million study and planning effort to prepare the Japanese computer industry and all suitable large manufacturers for the impact of artificial intelligence. This study is expected to take two years and to conclude with $4 billion of public support to develop the so-called "fifth generation" computer technology (symbolic computers, VLSI design, artificial intelligence) over the following ten years.

Management feels that the impact of this Japanese support of computer technology on United States government policy and American industry will resemble that of the similar Japanese government support of robotics. Namely, the use of industrial manipulators ("robots"), primarily developed in the United States, grew at a lackluster pace until Japan focused on their use in industry. The resulting productivity increase to Japanese manufacturing gave their products an economic advantage on the world market, where labor costs were becoming a dominant and seemingly uncontrollable factor in product pricing and competitiveness. The economic pressure of increasing Japanese productivity, resulting from increased automation, is popularly viewed to be the result of the use of robotics and has brought enormous effort to bear in the United States and the rest of the world to increase the use of industrial robots. A similar increase in the general world awareness and use of artificial intelligence, symbolic computing and AI based VLSI design techniques is expected to result from the Japanese focus on this technology.

Symbolic Mathematics

There are approximately 50,000 applied mathematicans, scientists, engineers and other professionals who use symbolic algebra, calculus, transform mathematics and differential

equations in their daily activities. Most of these calculations are currently performed by hand.

The Company is currently negotiating a license for a software package called MACSYMA which was developed at MIT, is written in LISP and embodies over 50 man-years of design and programming effort. MACSYMA is used for performing symbolic, as well as numerical, mathematic manipulations and incorporates most of the widely used operations of applied mathematics. It can differentiate and integrate, solve differential equations and systems of linear or polynomial equations, manipulate matrices, do transform operations and expand functions in Taylor series. MACSYMA is not currently being marketed commercially and almost all of its 2,500 users access it at MIT and the University of California at Berkeley over the ARPANET computer network. Examples of the use of MACSYMA are shown in Appendix D - "EXAMPLES OF SYMBOLICS COMPUTER APPLICATIONS".

MACSYMA is a good example of an application program which suffers in its use from the compromises of time sharing. The LISP Machine has proven to be a natural and effective machine on which to use MACSYMA.

Logic Circuit Design

There are several tens of thousands of electronic engineers involved with the design of printed and other types of logic circuits. Logic design is the symbolic representation of the relationships between, and the functions of, the basic elements (semiconductors and integrated circuits) which combine to form electronic logic. Semiconductor devices can range from a simple transistor to a complex integrated circuit ("IC"). IC's can contain electronic components representing the logic equivalent of over 100,000 transistors, all on a single "chip" of silicon. When interconnected by way of PCB's or other methods, they form the basic building blocks for all electronic equipment. Products ranging from electronic games and automobile ignition systems to the most technologically advanced computer, office equipment, telecommunications and defense systems are made this way.

The task of the logic designer can be considerably eased by the use of computer-aided design ("CAD") tools. There are a number of logic drafting programs commercially available from several vendors, which have libraries containing descriptions of semiconductor devices required to perform specific logic functions. The designer indicates to the computer which functions he requires and how he wants them interconnected. The program will then develop a schematic representation of the logic. A logic schematic of a DEC PDP-10 CPU equivalent circuit is shown in Appendix D. In some systems, another program will work from the logic schematic and simulate its logic operation. This enables the designer to insure that the overall design is correct and that the circuit operates according to the original specification. By the end of 1981, Symbolics plans to offer a

logic design package which, while containing the above programs, will also be able to generate the pattern for a PCB routing, a wire wrap connection list or a multiwire connection list. PCB's, wire wrap and multiwire are all standard production methods for interconnecting semiconductor devices. It will be possible to use the PCB routing diagram directly to generate the photo mask used in the manufacture of PCB's. To managements' knowledge, no commercially available package combines all these facilities at the present time. The market for computer-aided logic design packages is estimated by McGraw Hill Publications to be approximately $100 million in 1981.

Genetic Engineering

Symbolics is engaged in discussions to get a nonexclusive license for a software package called MOLGEN, used for the planning of experiments in molecular genetics. The program was developed at the Stanford University Medical School and is not at present marketed commercially. One program is used to plan DNA structural analysis experiments which identify unknown DNA structures. The system contains information about all major physical techniques used in elucidating the structure of nucleic acids. Another program is used to plan structural synthesis experiments to form particular DNA structures and is used to plan gene-cloning experiments. Plans for both types of experiments involve laboratory goals, initial conditions, a set of laboratory techniques that can be incorporated into the plan and a set of laboratory objects (for example, DNA sample cultures and enzymes), which can be manipulated and modified by the steps in the experiment. There are several hundred thousand known DNA sequences and the number is growing very rapidly. Without access to the MOLGEN data base of such known sequences, experiment planning becomes a substantially more time-consuming task. There are currently over 200 industrial companies and universities, employing over 3,000 scientists, working in the field of molecular genetics.

Additional Markets

Symbolics intends to position itself to be able to take advantage of whatever opportunities appear attractive, and profitable. There are a number of areas which are attractive, including industrial expert systems, medical advisory systems, process control systems and data base management systems.

In many industries there are acknowledged experts with specialized knowledge who are in short supply. For example, in the oil services industry there are people who are experts in reading oil drilling logs (an oil drilling log is the record of measurements of certain physical properties returned by instruments lowered into bored holes). One of the major focuses in geological formation evaluation is to determine the type, quantity and location of recoverable hydrocarbons. Log interpreters apply their experience, physical principles and

supplemental information, such as geological and geophysical data, to predict the empirical relationships between the measurements and the physical environment. This expertise is developed over years of reading logs in every conceivable situation, and consequently there are relatively few expert log interpreters. Because they are making multi-million dollar decisions, incorrect interpretations can prove very costly. Schlumberger, the leader in these services, is investigating the use of artificial intelligence techniques to develop software which will carry out much of the interpretation and ensure that higher quality decisions will be made by less skilled interpreters. This software is being developed in LISP and Schlumberger has expressed an interest in using the Company's systems for the operation of such software.

Similarly, in the medical field, there are relatively few doctors who are expert in any specific aspect of medical knowledge. The amount of knowledge that a doctor must learn is constantly increasing, forcing increased specialization. Artificial intelligence research using LISP is developing a series of advisory systems for doctors which incorporate as much of the available knowledge about a particular field as is possible. For example, a digitalis therapy program exists which incorporates almost all that is known about digitalis therapy so that optimum levels for digitalis can be administered. Another program helps the diagnostician reach very rapid decisions concerning the advisability of surgical procedures in cases of acute abdominal problems. None of these systems is yet available comercially.

Artificial intelligence techniques are used in process control systems for interrogation, control and optimization of large physical systems, such as chemical plants or oil refineries. Because these plants are usually extremely complicated, with hundreds of feedback loops and thousands of sensors and actuators constantly being monitored, it is of the utmost importance that the operator interface be intelligent in order to reduce the chance of operator error. With the large number of different error conditions and the relatively quick response required for many of them, the control system must be able to explain itself quickly and to any depth required. The control system should be able to provide a complete list of alternative options, under what conditions the options should be taken and the consequences of such options. Moreover, the system should be intelligent enough to question the operator when he does something the system considers dangerous. Such intelligent interaction is one of the domains of artificial intelligence.

Existing data base management systems have reached the point where they can store thousands of relationships in a relatively high level way. However, these systems have little self-understanding. Intelligent data base systems can be defined as those that store information in a far more structured way than at present and also participate actively in the user's quest for

a fact in the data base. Thus, not only does such a data base "know" a fact, but it also can help the user find it. Such data bases can be used by people who know little about a particular data base.

2.2 SYMBOLIC COMPUTING

LISP is a computer programming language which originated as a tool to facilitate artificial intelligence research. Artificial intelligence is a branch of computer science that seeks to understand and model intelligent behavior with the aid of computers. Intelligent behavior involves thinking about objects in the environment, how objects relate to each other, and the properties and uses of such objects. LISP is designed to facilitate the representation of arbitrary objects and relationships among them. This design is to be contrasted with that of other languages, such as FORTRAN, which are designed to facilitate computations of the values of algebraic formulae, or COBOL, which is designed to facilitate processing the books and records of businesses.

The acronym "LISP" stands for "List Processing Language", as it was dubbed when Professor John McCarthy of MIT (now of Stanford University) invented LISP in the 1950's. At that time, the notion of representing data objects and complex relations between them by "lists" of storage locations was novel. LISP's notion of "object" has been incorporated into many subsequent languages (e.g., SIMULA 67), but management believes that LISP and the languages derived from it are the first choice of artificial intelligence researchers all over the world.

LISP also facilitates the modeling of procedural knowledge (i.e., "how to do something" as opposed to "what something is"). All procedural knowledge is expressed as "functions", computational entities which "know how" to perform some specific action or computation upon supplied objects. Although the text of LISP functions can be from one line to several thousand lines long, the language imposes no penalty for dividing a program into dozens or hundreds of functions, each one the "expert" in some specific task. Thus, LISP facilitates "modularity", the clean division of a program into unique areas of responsibility, with well-defined interaction. The last twenty years of experience in the computer science community has established the importance of modularity for correct program operation, maintenance and intelligibility.

LISP also features "extensible syntax or notation". This means that language constructs are not limited to those supplied, but can include new constructs, defined by the programmer, which are relevant to the problem at hand. Defining new language constructs does not involve modification of the supplied software, or expertise in its internal details, but is a standard feature of the language available to the applications (and systems) programmer, within the grasp of every beginner. Through

this feature, LISP can incorporate new developments in computer science. Indeed, the Low Cost Computer (see "THE COMPANY'S PRODUCTS") includes technology from "object oriented programming", and future advances can be integrated easily.

LISP frees programmers from the responsibility for the detailed management of memory in the computer. The common FORTRAN and PL/I decisions of how big to make a given array or block of memory have no place in LISP. Although it is possible to construct fixed-size arrays, LISP excels in providing facilities to represent arbitrary-size objects, sets of unlimited numbers of elements, objects concerning which the number of details or parameters is totally unknown, and so forth. Antiquated complaints of computers about fixed-size data stores ("ERROR, 100 INPUT ITEMS EXCEEDED") have rightly inspired popular ridicule of computers, and are eliminated in systems written in LISP.

LISP provides an "interactive environment", in which all data (knowledge about what things are and how they are) and functions (knowledge about how to do things) co-exist. Data and functions may be inspected or modified by a person developing a program. When an error is discovered in some function or data object, this error may be corrected, and the correction tested, without the need for a new "run". Correction of the error and trial of the repair may sometimes be accomplished in three keystrokes and two seconds of real time. It is LISP's notion of an interactive environment which allows this "incremental debugging" approach, which in turn allows both novices and experts to develop massive systems a layer at a time. It has been observed that LISP experts enter programs directly without need for "coding sheets" or "job decks"; the program is written, entered, and debugged as one operation. Functions can be tested as they are written, and problems found. The computer becomes an active participant in program development, not an adversary. Programs developed in this way build themselves from the ground up with solid foundations. Because of these features, LISP program development is very rapid.

LISP offers a unique blend of expressive power and devlopment power. Current applications of LISP span a broad range from computer-aided design systems to medical diagnosis and geophysical analysis for oil exploration. Common to these applications is a requirement for rapidly constructing large temporary data structures and applying procedures to such structures (a data structure is a complex configuration of computer memory representing or modeling an object of interest). The power of LISP is vital for such applications.

2.3 THE COMPANY'S PRODUCTS

Overview

The LISP language system can be run on a number of

different types of computers, with the majority of the work in LISP to date having been carried out on the Digital Equipment Corporation ("DEC") PDP-10 series. However, none of the presently available computers, apart from the LISP Machine discussed below, has been designed specifically to provide an optimum operating environment for LISP.

In the early 1970's, the MIT Artificial Intelligence Laboratory ("AI Lab") initiated a project to design a computer to provide a flexible, interactive, large address space system for the efficient operation of LISP. The development of the MIT LISP Machine has been completed and a total of over twenty machines have been built at MIT during the last two years with a total production run of thirty being projected. The construction of the first six LISP Machines was funded by the Advanced Research Projects Agency ("ARPA") of the Department of Defense whose commission is to fund developments which can be transferred to industry within five years. Those machines currently in use are all situated at MIT, except for two machines which are being used by Xerox Corporation at its research center in Palo Alto, California.

The hardware features of the LISP Machine include a large word length, a "tagged" architecture, special-purpose internal processor memories, and a high-performance CRT display system. The LISP Machine uses a 32-bit word which combines a 24-bit address space together with eight indicator bits. The designers of the LISP Machine focused considerable attention on providing efficient features to create and execute large programs with increased ease and reliability and to represent list structures, which encompass both LISP programs and data. Many of the unique features of the LISP Machine have been implemented by way of the "tagged" architecture employing eight tag bits in each word. Five of these bits are used to define the type of data item, two are used for a special list compression facility whereby lists are stored in a special order which halves the memory required for a typical list, and one bit is used for storage management purposes. A more detailed description of the hardware features is given in Appendix C - "TECHNICAL DESCRIPTION OF COMPUTER HARDWARE AND SOFTWARE".

Perhaps the most important feature of the LISP Machine is its ability to provide dramatic increases in programmer productivity. This is achieved through three principal areas, the single-user concept, the advanced interactive CRT display system and the high level of programming tools available.

A key architectural concept exploited for the LISP Machine design is that of the single-user computer. Where an individual user has a complete personal system at his disposal he has the advantage of consistent performance without the delays in response time which can result using time-sharing. Time-sharing has the advantage of flexibility in meeting the demands of a large number of users and works well when the demands of an

individual user are small and the aggregate demands of all users do not exceed the available resources. If enough of the users of a time-shared facility attempt to run large programs, as is often common in a LISP environment, then the ability of the system to service them is severely limited.

Time sharing makes a compromise in favor of lower equipment cost per programmer at the expense of inconveniencing and reducing the productivity of the programmer. The LISP Machine design seeks a new balance of higher computer cost and compensatingly greater programmer productivity through greater use of the computer to unburden the programmer. The trend in falling computer costs and increasing programmer costs strongly favors this new design objective.

Resources can, nevertheless, be shared in a personal computer environment by clustering processors together. Such a pool of processors, linked by a highspeed network, has numerous advantages over a large mainframe computer. Resources such as high quality printers, file systems and special input/output devices can be efficiently shared in a network-based configuration. Since processors may be added one at a time, the process of system expansion can occur more smoothly and in less expensive steps. A network configuration is inherently far more reliable than a large mainframe since, if one processor breaks down, only a relatively small part of system capacity is lost.

The LISP Machine CRT display window system partitions the screen into separate areas or windows. Windows may be created, moved around the screen, enlarged or contracted, all under direct user control. Windows can overlap each other and can be as large as the entire screen or as small as a postage stamp. Each window is effectively a separate mini-display which operates completely independently of every other mini-display and allows the programmer to have a number of different program environments operating and visible simultaneously. This facility, which gives programmers more information viewable at any given time than is possible with a more conventional system and provides them with an adequate display area to pursue several activities simultaneously, contributes to the ability to generate programs more quickly than is usually possible with more traditional types of machines and languages.

Management believes that an important feature of the LISP Machine is the capability of its system software which controls the resources within the computer system and supervises the execution of applications programs. The software has extensive interactive tools to assist the programmer in generating, executing and correcting programs. A description of these features is given in Appendix C - "TECHNICAL DESCRIPTION OF COMPUTER HARDWARE AND SOFTWARE".

Development Computer

It is estimated that the Company's first computer (the "Development Computer") will be manufactured and available for use during the second quarter of 1981, with the first customer deliveries being made in mid-1981. The first four machines manufactured will be used in-house to assist in the initial production checkout of subsequent machines, completion of the software development for the initial model and the hardware and software development for subsequent models.

The initial machine to be manufactured by the Company will have an identical hardware architecture to the MIT LISP Machine. However, it will be redesigned physically for maintenance and ease of testing production. The MIT LISP Machine was designed for a research environment where ability to modify the hardware was of greater concern than physical compactness or ease of production. The software for the re-engineered system will remain compatible with the existing MIT LISP Machine software which currently comprises over 300,000 lines of programming. Additional documentation will be created to facilitate commercial distribution of the existing software. Certain areas of software will be refined to enable the Development Computers to operate totally as stand-alone systems. At present, the LISP Machines are connected to various main-frame computers via local networks and certain file-handling activities take place at the remote main-frames. A stand-alone file handler is being written and an existing extensive library of diagnostic aids will be augmented to facilitate hardware checkout in production and in field maintenance. It is estimated that the total software design task for the initial model will require approximately 10 man-months of effort. Most of the results of this effort will be usable on future models.

The basic Development Computer system will consist of a central processor, a 256K word main memory, a CRT display and keyboard, an 80 mega-byte disk drive, a hand-held pointer for display, and an interface to the local CHAOSNET computer network. Primary options will be a 300 mega-byte disk drive, a high-resolution color display, a magnetic tape drive and an array processor. It is anticipated that, where a Symbolics system is used at computer centers having other Symbolics systems and/or mainframe computers, the Symbolics system will be connected by way of a CHAOSNET or ETHERNET local network for the other computers to enable it to share certain resources such as disk drives and printers. The retail price of a system will depend on the memory size, the peripherals and other options chosen, but it is anticipated that a typical system will sell for approximately $99,000.

Low-Cost Computer

The Company will use the Development Computer system to

design the first commercial computer (the "Low-Cost Computer"). The Low-Cost Computer system is projected to be approximately three times as powerful as the Development Computer system, but will sell at approximately 70% of the price; typically, about $70,000 for a machine of average memory size. Development work has commenced on the design of the Low-Cost Computer, with the primary design objectives being to minimize costs yet retain high programmer productivity. A standard configuration is projected to consist of a central processor, a 256K word main memory, a high resolution CRT display and keyboard, a low-cost 50 to 80 mega-byte Winchester disk drive, a local high-speed network connection and a hand-held display cursor pointer. Enhanced performance and expanded storage capacity options will be introduced later.

Management estimates manufacturing costs of the Low-Cost Computer to be less than half the cost of the Development Computer due to several factors. First, a number of components in the Development Computer are kept separate in the hardware design to provide the ability to modify the hardware in a research environment. The Development Computer has a very flexible design, incorporating considerable generality not needed in a production model. The elimination of this unneeded generality together with design optimization will reduce component costs significantly. Second, the hardware architecture of the Low-Cost Computer will be different from that of the Development Computer and will take advantage of the improvements in the scale of integration available with more modern integrated circuits, further reducing component costs. Other features contributing to lower component costs include the replacement of a standard disk drive with a lower cost Winchester disk drive, and a major reduction in the cost of the microcode memory resulting from the new design approach mentioned above.

It is estimated that the Low-Cost Computer will require approximately 24 man-months of hardware development and thirty man-months of software development, all of which should be completed by the third quarter of 1981. Deliveries are expected by early 1982. This model will be designed with economy, ease of manufacture, serviceability and reliability as primary goals. When time permits, an array processor will be developed which can be added, at a user's option, to form an integral part of the hardware. New microcode software will be developed for this computer, but it will remain compatible with all of the higher level software available on the Development Computer. The development cycle for this and subsequent LISP Computers will be shorter than is traditionally required as a result of the extensive experience of the hardware and software designers of the LISP Machine, the technologies which will be used for the design of this system and the advanced design tools which will become available.

A factor of four increase in speed over the Development Computer will be achieved as a result of two design decisions.

First, by using carefully selected architectural features, the time required to execute the most probable instructions will be reduced by as much as a factor of six to eight. Second, a judicious choice of instruction format and functionality will allow a more efficient compilation and execution of LISP programs. Modest improvements are also expected from the use of newer integrated circuit technology and an improved memory bus design. Certain innovative hardware features will make the management of storage much more efficient as compared with any existing computer. The design team will use their extensive experience gained to date on the LISP Machines, resulting from metering the frequency of use by representative programs, to provide a more optimal distribution of such functions between the hardware, software and microcode in the Low-Cost Computer.

As an early test and use of the Company's VLSI design capability, the Low-Cost computer's subsystems will be successively implemented as single IC modules. This evolution of the Low-Cost Computer is planned to extend its price and performance range as well as its product lifetime.

High Speed Computer

While the Low-Cost Computer is being developed and brought into production, design work will take place for a machine targeted to have five times the performance of the Low-Cost Computer (the "High Speed Computer"). The hardware architecture of this and subsequent models will share some features of the Low-Cost Computer. For this machine, performance rather than cost will be the primary criterion. The increase in performance will be achieved principally by the use of "Emitter Coupled Logic" ("ECL") integrated circuits, which operate at five times the speed of the "Transistor Transistor Logic" ("TTL") integrated circuits used on the earlier models. In addition, this computer will have a high-speed integrated array processor which will give it a typical "number crunching" power targeted to be more than one third that of a Cray I computer, the most powerful general-purpose computer on the market today, costing several million dollars each.

It is estimated that the design and development of the prototype of this computer will take two years, with initial sales being made on a test basis in late 1982.

Integrated Computer

After introducing the High Speed Computer, the Company intends to market a very low-cost system (the "Integrated Computer") in the $10,000 to $50,000 price range. Production costs will be kept to a minimum by the use of VLSI circuits developed by the Company's designers using the Company's VLSI design software (see "MARKETS"). The average sales price of the Integrated Computer is estimated to be in the $30,000 range, with initial sales to take place in 1985. This computer will be aimed

initially at similar markets to those of the Low-Cost Computer but the reduced cost of a system operating, for example, the logic design package or the MACSYMA mathematical computation package (see "MARKETS") is likely to substantially increase the market size for such packaged systems. In addition, this computer will be used to enter markets such as process control and data base management which might present attractive opportunities for the Company during the mid to late 1980's.

MIT License

The Company has a non-exclusive license from the Massachusetts Institute of Technology ("MIT") to use and sell the LISP Machine software (the LISP Machine hardware designs and technology are in the public domain and are freely available). Under the terms of the license, the Company made an initial payment of $20,000 and agreed to pay an additional $60,000 by September 30, 1982. In addition, the Company must pay to MIT a royalty on all sales where only MIT licensed software is sold and a royalty of 1% of all sales of certain hardware or combined hardware and software. The term of the license is three years, renewable for two additional three-year periods at the option of the Company. The Company is entitled to any Enhancements (as defined) developed by MIT for the LISP language system, but is not entitled to any applications software. The Company is required to give to MIT any Enhancements which it might make to the LISP language system, but MIT may not distribute such Enhancements to others. To date, MIT has granted one other license for the LISP Machine software (see "COMPETITION"). The Company is not aware of any plans by MIT to issue further licenses at the present time, although it is possible that such licenses may be granted at any time in the future.

Future Licenses

The Company is negotiating with MIT for a non-exclusive license to use the symbolic mathematic computation software package MACSYMA and hopes to obtain such a license in the first half of 1981. No licenses have so far been granted for the use of MACSYMA. Part of the funding for the development of MACSYMA was provided by the United States Department of Energy, which has a policy that the results of any projects funded by it belong to the public domain. Should MACSYMA be declared to be in the public domain after the Company obtains a license, the license would thereafter become null and void and MACSYMA would thereafter be freely available to the Company, as well as to its competitors.

Management plans to license from outside sources the majority of its applications software. Much of the LISP software currently available is either university owned, government owned or in the public domain.

With respect to the molecular genetic engineering package

MOLGEN, it is anticipated that the Company will obtain a non-exclusive sublicense from a company being formed by certain of the leading developers of the package, who are currently negotiating with Stanford University for an exclusive license.

Much of the software which the Company hopes to use as part of its VLSI design system has been developed, or is under development, at various American universities. No assurances can be given that the Company will be able to obtain licenses for MACSYMA, MOLGEN, the VLSI design software or other university-developed software which the Company may wish to market. In the event the Company cannot obtain such licenses, its future expansion may be adversely affected (see "RISK FACTORS").

The Company plans to protect its own hardware and software designs (to the extent possible) with patent coverage. No patents are presently held by either MIT or the Company in the Company's product area. Management hopes to obtain patents on its Low-Cost Computer and High-Speed Computer systems design architecture and will seek patents on key ideas in the operating systems software. Generally, management plans to patent, copyright, or retain as trade secrets all hardware and software innovations developed by the Company which might give the Company a competitive or economic advantage.

Sublicenses

The Company intends to offer software and hardware independently. Each software product will be offered with a sublicense to use but not to redistribute. With each software sublicense will be included various forms of support. Typically, a sublicense will provide documentation and support for the first year after purchase. Successive years' documentation and support will be offered under update sublicenses. Additional sublicenses and update sublicenses will be offered at lower prices than the first such sublicense.

2.4 MANUFACTURING

The Company will design the central processors, peripheral controllers and main memories used in its computers and, in general, use standard components and subassemblies. However, certain items such as printed circuit boards ("PCB's") will be made to the Company's specifications. The Company intends to subcontract all work in the manufacture of the PCB's and the insertion of semiconductor devices into the boards and, on a permanent basis, to limit its in-house manufacturing operations to procurement and inventorying of components and sub-assemblies, and final assembly and testing of systems. Other components of the systems which are standard, commercially available designs such as disk drives, CRT displays, keyboards and power supplies will be bought directly from manufacturers. The Company's manufacturing process will consist primarily of purchasing,

material control, production control, assembly and testing. The components and subassemblies will be assembled, integrated into a computer mainframe and tested. Components, subassemblies and finished goods will be tested independently.

The Development Computer will be a re-engineered version of the LISP Machine. Most of this re-engineering work has already been completed. All the circuit boards have been designed and orders placed for their initial production. Industrial design work is currently being done to re-package the Company's initial computer and display system.

Most of the components and subassemblies used in the Company's products will be available from a number of different suppliers. The Company will maintain multiple sources of supplies for most items and will stock ahead on single source items. The Company believes that alternative sources could be developed, if required, for such single source items.

The Company has accepted delivery of a Foonly F2 computer at the Cambridge Research Center. The Foonly is a DEC PDP-10 compatible computer, co-designed by one of the Company's founders, but sold at a much lower cost than the DEC machine. Initially, this computer will be used for the limited amount of software development that will be necessary to enable the Development Computer to operate as a stand-alone system. The Company is developing a file-handler for the Development Computer, using the Foonly system. It is anticipated that the additional software for the Development Computer will require approximately six man-months of programming effort.

The first Symbolics computer is expected to be available for hands-on use at the Company's Cambridge, Massachusetts facility in June, 1981. The hardware will be tested using the Foonly computer, which has software available for hardware debugging of the Development Computer. The first four machines manufactured will be retained for in-house use, three at Cambridge, Massachusetts and one at Woodland Hills, California. The Cambridge machines will be used for development purposes, whereas the California machine will be used for hardware debugging and testing of production models. The Company plans to deliver the first machine to a customer in July, 1981, with the initial production rate starting at two systems per month until November, 1981. Up to 12 of the Development Computers will be sold to selected users through the second half of 1981.

The Company will initially offer maintenance service on an hourly-charge basis, but once cost experience has been gained in this area, it will offer annual maintenance contracts. Because subassemblies of the Company's systems will be modular, maintenance will generally be performed by replacing (rather than repairing) malfunctioning subassemblies in the field. Test, verification and diagnostic software will be included with the computers to enhance system reliability, availability and

serviceability in the field.

2.5 MARKETING

The initial marketing emphasis will be in three major areas. First, the systems offering the LISP language will be marketed to the 50 university, government and industrial research laboratories which are carrying out artificial intelligence research or developing application packages using artificial intelligence or symbolic computing techniques. Second, the Company expects to market, under license, software packages developed elsewhere. The MACSYMA symbolic mathematics package will be marketed to the large number of companies and research laboratories where physicists, mathematicians and engineers are required to carry out high levels of symbolic mathematical calculations. The Company also expects to be able to offer the MOLGEN molecular genetics system to the approximately 200 companies worldwide carrying out molecular genetic research and development. Third, commencing in 1982, the Company plans to market a comprehensive package for the logic design of electronic circuits. At the present time, the Company does not have any formal license agreements with respect to either MACSYMA or MOLGEN.

Beginning in 1983, a major thrust of the Company's marketing effort will be the sale of Low-Cost and High-Speed Computers, together with a comprehensive software package, to the VLSI design market. As explained previously, the VLSI market can be divided into two segments (see "MARKETS"). First, there are the manufacturers of high volume IC's, such as Texas Instruments, Motorola, Fairchild and Intel. Second, there is the custom VLSI design market. This market can also be split into two segments: some major manufacturers of IC's also do custom IC design work. The number of such companies is likely to increase once powerful design software becomes available. However, the Company believes that most of the demand for custom VLSI chips will be met by small design houses in much the same way as many software products are produced by small software houses. The company intends to provide a means, through the sale of its computer systems and VLSI design software, whereby independent IC designers can enter the "design for hire" market. The Company will provide its customers with full training in the use of the hardware and the software, systems improvements and various other support services.

The rapid program development aspect and large computational capacity of the High-Speed system make it a natural for certain classes of large problems. Economic modeling, plasma fusion modeling, cosmic modeling and weather modeling are examples of problems that require both extensive continuous program development and large processing power to run. In addition, the High Speed system can be used for parametric simulation of large integrated circuits.

As production costs go down due to increasing integration on the Low-Cost products, broader markets will be developed. The power of the operating system to deal in concepts and relationships (see "SYMBOLIC COMPUTING") makes it especially attractive for implementing a relational data base system. Subject to marketing capacity limitations, the data base management market will be probed in the mid 1980's. At this time, management believes the Company's products will achieve a significant performance edge in the data base management market of the mid 1980's.

2.6 COMPETITION

Competition in the market for the Company's proposed computer systems is presently offered only by Digital Equipment Corporation ("DEC") and LISP Machines, Inc ("LMI"). However, once the market expands, it is possible that other computer companies may market competitive systems and that such companies, like DEC, will have established reputations and far greater financial, technical and operating resources than the Company.

The most widely used implementation of LISP has been on the DEC PDP-10 series, a family of computers originally designed about ten years ago. In 1978, DEC introduced the VAX series of medium-size computers. Development work is currently being carried out to implement both the INTERLISP and MACLISP language systems on this series. While both of these series are now more expensive than the projected price of the Company's Low-Cost Computer, DEC has announced that it will shortly be introducing a smaller, less expensive model of the VAX which will be more cost-effective than the earlier model VAX.

Within the artificial intelligence community, there is a large amount of LISP software available for the PDP-10 series, but management believes that the competition from both this and the VAX series can be met because of several factors. First, both series of DEC computers were designed as general purpose machines and consequently are not as well suited to the development and use of LISP programs as are the computers to be offered by the Company. Second, the Company's machines are single-user computers with software tailored to both an individual interactive environment and the running of very large programs, while the DEC systems are aimed at time-shared environments and are tailored to run many small programs simultaneously. The Company estimates that the cost of a PDP-10 system capable of running more than three large LISP programs without a significant degradation for the other users of the system would be many times greater than the proposed cost of the Company's systems. Third, the Company's systems have already received the benefit of many man-years of software development, and management believes that the Company's computers are ahead of the VAX with respect to software.

Several computer systems exist on the market which are in

the same class as the DEC VAX, including models by Data General Corp. and Prime Computer Corporation. These machines also require a long lead time for software evolution and are unlikely to be directly competitive in the near future.

MIT has, to date, granted two licenses relating to the LISP Machine, one to the Company and the other to LMI. No assurances can be given that MIT will not grant further licenses in the future. LMI, based in Los Angeles, California, was established in 1980 by Richard Greenblatt, a member of the MIT Artificial Intelligence Laboratory. The Company believes that LMI plans to have initial production of the MIT LISP Machine, which it has not re-engineered, in the Spring of 1981, and that LMI proposes to sell its machines in pairs, to enable one machine to identify hardware faults in the other machine.

The Company believes that it will be able to meet the LMI competition for two principal reasons. First, only a very limited number of the Development Computer systems will be sold and those to customers wishing to make a start on their own software development for use with the future Low-Cost Computer. Second, the Low-Cost Computer will have approximately four-times the performance of the LMI computer at a projected lower cost and with more advanced software.

Other possible competitors in the high cost single-user computer market are Apollo Computer Company, Inc.; Bolt, Beranek and Newman, Inc.; Hewlett-Packard, Inc.; IBM; Three Rivers Computer Corporation; and Xerox Corporation.

Apollo Computer makes a 32-bit microprocessor-based display system. Although powerful in the old computer architecture sense, these systems are not well suited for implementing list processing languages such as LISP. This deficiency prevents them from simply running the LISP operating system and gaining its benefits.

Bolt, Beranek & Newman has developed an InterLisp computer, the Jerico, which it is implementing InterLisp on. This system will have approximately one sixth the power of the Symbolics low cost computer and will sell for approximately $40,000. Whether the Jerico will be sold is uncertain at this time.

Hewlett-Packard has been increasing its exposure in the single-user computer market and has shown an interest in the high end of this market. However, due to Hewlett-Packard's size it is considered unlikely that it would wish to enter the Company's market, at least initially.

Although IBM has two systems which could possibly be converted into competitive machines (the System/38 and the Watson Research Lab 801), it is considered unlikely that IBM will move into the Company's market as it would represent a major change in its marketing direction.

Three Rivers Computer currently markets a PASCAL language-based personal computer in the $20,000 to $40,000 price range. This system, the PERQ, is currently widely regarded as the best existing candidate for developing and running large programs. Management believes that redesign and reprogramming to produce a model competitive in price with the Company's Low-Cost Computer, will take Three Rivers more time than will be required for the Company's products to become established in the market. The important element in this estimate is software development time; the Company's programmers believe that the Three Rivers effort will require over 9 man-years.

The depth of experience in Xerox Corporation's Palo Alto Research Center ("PARC") in both single-user computers and large systems programs is extensive. PARC has had long term involvement with the INTERLISP language. Xerox has indicated that it intends to market a computer, known as the Dolphin, which runs INTERLISP. Xerox's stated intention is to provide Dolphin hardware in limited quantities to INTERLISP researchers. Xerox is currently stating the Dolphin's operating system will be unsupported. The main factor which would make the Dolphin a strong competitor is the expected availability of 60 units in 1981; such availability will be attractive to facilities eager to upgrade their capacities.

The Company does not plan to compete directly with the large scientific systems manufactured by companies such as Cray Research, Inc. and Control Data Corporation.

With respect to its application software packages, the Company is likely to have competition from a number of areas. If the Company obtains a license on MACSYMA from MIT, it will be non-exclusive. MACSYMA may also become generally available without charge from Berkley. There are other packages marketed in this field, including SCRATCHPAD by IBM and REDUCE by the University of Utah. However, MACSYMA has significantly greater capability than the other packages available and it is anticipated that its use on the Company's computers will be more cost-effective than its use on other systems.

There are a number of companies offering CAD/CAM packages for logic and integrated circuit design, including Applicon and Calma. These competitors' packages are generally developed as logic and layout drafting aids only. Qualitative design capabilities, which are easier to develop on the Company's systems, are not generally available from existing CAD/CAM vendors. The Company expects its CAD/CAM products in the logic, integrated circuit and VLSI design fields will enjoy a strong competitive advantage.

Generally, the computer industry is also characterized by rapid technological advances which can be expected to result in new products being introduced on a regular basis. The Company would be adversely affected if its competitors were to introduce

technologically superior products or were to offer their products at prices significantly lower than those for the Company's products. The Company believes that the industry will continue to make significant technological advances and that competition will be significant. For this reason, the Company plans to continue to fund substantial engineering and development.

SECTION 3

3.1 MANAGEMENT AND KEY EMPLOYEES

The Company presently has two directors, Robert P. Adams, who serves as Chairman, and Russell Noftsker, who co-founded the Company with Mr. Adams. ~~Messrs. Adams and Noftsker~~ The Company intends to expand the Board to ~~nine~~ Seven members, a majority of whom will be unaffiliated with the Company.

The officers and senior employees of the Company are:

Name	Age	Position	Present Annual Salary
Russell Noftsker	39	Director, and President	$65,000
Minoru Tonai	51	Vice President-Finance Treasurer and Assistant Secretary	$62,500
Robert D. Chisum	42	Vice-President - Marketing	$62,500
John T. Holloway	~~35~~ 36	Vice President-Technology	$50,000
John V. Blankenbaker	52	Vice President-Engineering	$50,000
John L. Kulp	~~34~~ 32	Director, Director of Cambridge Research Center, ~~and Assistant Treasurer~~ and Secretary	$50,000

Russell Noftsker has worked since 1978 to establish the Company. During that time he also consulted for General Motors and Pertron Controls, Inc. in the area of computerized resistance welding controls. From 1975 to 1978 he was employed by Pertron (a manufacturer of programmable microcomputer resistance welding controls) as Vice President. He co-founded Pertron, and has been on its board of directors since 1975. From 1965 to 1974, he was a founder, chief engineer and General Manager of the Artificial Intelligence Laboratory at MIT. He holds a B.S. degree in Electrical Engineering, with minors in Physics and Mathematics from New Mexico State University.

Minoru Tonai has been employed since 1977 as Vice President of Finance, Treasurer, Secretary and member of the Executive Committee of the Board of Directors of Compucorp, a manufacturer of word processing equipment. From 1974 to 1977, he was initially Vice President of Finance, Treasurer and Secretary of Xincom Corporation, a manufacturer of semiconductor test equipment, and later also Vice President of Operations and, following the sale of Xincom to Fairchild Instrument and Camera, Inc., Director of Finance and Administration and later Director of Business Development for the Fairchild Systems Division. Prior to 1974, he was Vice President of Finance and Treasurer of Pertec, Inc., Corporate Controller, Assistant Treasurer and chief accounting officer at Informatics Inc., and Manager of Profit Planning and Analysis at TRW, Inc. He has a B.S. degree in Business Administration from UCLA. Mr. Tonai is presently working three days a week for the Company under a three month planned phase-out from his duties at Compucorp. Mr. Tonai will join the Company full-time on 1 May, 1981.

Robert D. Chisum joined the Company in May, 1981. Since September, 1980 he has beenamarketing consultant and has provided services to the Company since April, 1981. From November, 1978 to September, 1980, Mr. Chisum was Vice President of Marketing at GENRAD/Futuredata Corporation. From January, 1978 to November, 1978 he was Vice President of Marketing and Sales at Micropolis Corporation. From September, 1976 to January, 1978 Mr. Chisum was Marketing Manager at PERTEC Computer Corporation Microsystems Division. Between May, 1975 and August, 1976 Mr. Chisum founded and ran ACTUS Corporation which he sold in July, 1976. From March, 1971 to April, 1975, Mr. Chisum was Director of Marketing for the Computer Products Division of Electronic Memories & Magnetics Corporation. Between February, 1970 and March, 1971, Mr. Chisum was Vice President of Marketing for MCA Technology, Inc. Mr. Chisum has a B.S. degree in Finance and Engineering from Sacramento State College obtained in 1962, and a M.S.B.A. in Finance and Management Theory from University of California at Northridge obtained in 1968. Advanced studies include one year of law school in 1970 while working at DYNASCIENCES Corporation.

John T. Holloway was a Principal Research Scientist and co-leader of the VLSI research group at the MIT Artificial Intelligence Laboratory until joining the Company full time in

December, 1980. At MIT since 1965, he did work in computer architecture, VLSI design, CAD/CAM software development, machine vision, and robotics. Most recently at MIT he was co-designer of the Scheme 79 LISP microprocessor, a five week design effort which yielded a working 18,000-gate, 32-bit microcomputer integrated circuit. For the last 6 years, he has participated in the design of the MIT LISP Machine in addition to designing its high resolution display and CHAOSNET high speed local network. From 1969 to 1970, working at Stanford University, he co-developed the ARPA funded Super Foonly computer which was later produced by Foonly, Inc., a company he co-founded as President. Mr. Holloway will continue to serve as a director of Foonly, Inc., which produces a line of DEC PDP-10 compatible computers and integrated display products. Mr. Holloway also co-founded Symbolic Systems, Inc. (not affiliated with the Company), a manufacturer of bit-map displays, and served as its President.

John V. Blankenbaker was Director of Engineering from 1973 to 1980 at International Communication Sciences, Inc., a manufacturer of voice and picture compression communications equipment. From 1970 to 1973, he was President and founder of Kenbak Corp., a manufacturer of educational computers. From 1962 to 1970, he was Vice President of Engineering at Scantlin Electronics, Inc, (now Quotron, Inc.) and was architect of the Quotron stock market monitor. He is a specialist in electronic manufacturing design, array processor design and high-speed computer design. He has a B.S. degree in Physics and Mathematics from Oregon State University, an M.S. degree in Physics from UCLA and an E.E. degree in Electrical Engineering from MIT.

John L. Kulp has been a plasma physics research scientist at MIT for many years. Most recently he has been Computer Services and Technology Group Leader at the MIT Plasma Fusion Center. He participated in the development of the MACSYMA symbolic mathematics software and the CHAOSNET local network and has extensive hardware design and systems programming experience. He is currently involved in the development of an advanced scientific computing environment based on the LISP Machine at MIT. He has a Ph.D. degree in Electrical Sciences and an Electrical Engineering degree from MIT.

In addition to those employees mentioned above, twelve others who were instrumental in founding the Company are now joining its research and development team. These employees are all stockholders of the Company. Eight members of this team are currently working at MIT and will be joining the Company on either a part-time or full-time basis during the first half of 1981. They are primarily hardware and software design experts and among them have been responsible for much of the design and implementation of the MIT LISP Machine, a new computer architecture designed to efficiently run list processing languages, in particular LISP. These experts designed all the LISP Machine hardware, implemented all the current system

software and have been involved in programming most of the applications software packages. These other founders of the Company, listed in alphabetical order, are as follows:

Henry G. Baker joined the Company in June, 1980 as Director of Marketing. Mr. Baker was previously an Assistant Professor of Computer Science at the University of Rochester. Among his achievements was the development of a manufacturing data base and product planning system for the Palm Beach Company, a clothing manufacturer. In addition, he conceived the real-time storage reclamation algorithm incorporated in the LISP Machine. Dr. Baker, who has had considerable experience with data base architectures, obtained his Ph.D. in Computer Science from MIT.

David Dyer is a systems programmer at Information Sciences Institute, where he is now implementing INTERLISP. He previously was employed as a systems programmer by Information International Inc. Mr. Dyer developed the systems software and microcode for the Foonly computer. He received a B.A. degree in mathematics at Immaculate Heart College.

Howard I. Cannon joined the Company two-thirds time in February, 1981 on the software development and support team. His previous employment was on the Research Staff of the MIT Artificial Intelligence Laboratory. Among his achievements are: co-development of a screen management system for the LISP Machine; conception and implementation of a computing paradigm, the Flavor System; implementation of the interim file system for the LISP Machine; and design of an interface for the SCHEME 79 chip to the LISP Machine. Mr. Cannon has had extensive experience in debugging LISP Machine hardware.

Bruce E. Edwards joined the Company full-time in March, 1981 on the software development and support team. He previously served on the Research Staff of the MIT Artificial Intelligence Laboratory, and as a system programmer at I.I.A.S.A. in Austria. Mr. Edwards is a UNIX expert, has had experience in debugging LISP Machine hardware, has participated in the development of the CHAOSNET, designed the convolution processor attachment for the LISP Machine, worked on LISP Machine system software and microcode, and maintained MACSYMA on the LISP Machine. Mr. Edwards obtained has a B.S. degree in Computer Science from MIT.

Bernard S. Greenberg joined the Company in January, 1981 as a member of the software development and support team. He previously was employed as a systems programmer by Honeywell. His achievements include: authoring the EMACS editing system (LISP-based) for Multics; design of a video terminal support system for Multics; implementation (with others) of the current Multics storage system; and, maintenance of Multics LISP. He has taught several courses on LISP and authored a comprehensive set of notes on LISP which has been widely distributed. Mr. Greenberg obtained a B.S. degree from Cooper Union, and an M.S. degree in Computer Science from MIT.

Thomas Knight joined the Company in January, 1981 as a member of the computer design team. He previously served on the research staff of the MIT Artificial Intelligence Laboratory. Mr. Knight is a co-founder and vice president of Symbolic Systems, Inc. (not affiliated with the Company). He is currently an MIT Ph.D. candidate in Computer Science. He is the principal architect of the original CONS processor and the current CADR processor of the LISP Machine, and designed the display system at the Artificial Intelligence Laboratory. Mr. Knight obtained B.S., E.E. and M.S. degrees in Computer Science from MIT. He will become a professor of MIT starting in September, 1981.

David A. Moon joined the Company part-time in January, 1981 as a member of the new product design and development team. He previously was employed as a member of the Research Staff of the MIT Artificial Intelligence Laboratory. Mr. Moon wrote much of the LISP Machine system software and microcode, designed the disk control, I/O board, and memory board for the LISP Machine, and conceived and developed MELTWAX, a hierarchical design system which runs on the LISP Machine. He also conceived and implemented the protocol used on the CHAOSNET, and is responsible for maintaining the I.T.S. systems at MIT. He also is the co-implementor of MACLISP on the Multics system. Mr. Moon received a B.S. degree in Computer Science from MIT.

Robert L. South is currently a software consultant to Digital Equipment Corporation, MIT Lincoln Labs, General Electric, General Motors and others. He previously served on the Research Staff of the MIT Lincoln Labs, and was a Staff Scientist and a member of the Research Staff of the MIT Artificial Intelligence Laboratory. Mr. South obtained a B.A. degree in Mathematics from MIT.

Christopher J. Terman is a Ph.D. candidate in Computer Science at MIT. A hardware/software engineer, he implemented a logic simulator for VLSI design on the VAX 780, participated in development of the Nu Personal Computing System at MIT, and is a UNIX systems expert. He obtained a B.S. degree in Computer Science from MIT.

Daniel L. Weinreb joined the Company in March, 1981 as a member of the software development and support team. He previously was employed on the Research Staff of the Artificial Intelligence Laboratory at MIT and was a systems programmer on the S1 Project at the Lawrence Livermore Laboratory. He was a co-designer of the Amber operating system for the S1 processor, a designer of the Zwei editor for the LISP Machine and its predecessor, Eine, participated in much of the early software development and documentation of the LISP Machine, and has had Multics systems programming experience. Mr. Weinreb obtained a B.S. degree in Computer Science from MIT.

Robert Williams joined the Company in November, 1980 as a manufacturing and test engineer. He previously was employed as manager of Test Engineering at ICS, Inc. (telecommunications) and

Xerox Corporation. He has considerable experience in the area of automatic testing. Mr. Williams holds a B.S. degree in Electrical Engineering degrees from California State University, Northridge.

3.3 FACILITIES

The Company's principal offices are located at 21150 Califa Street in Woodland Hills, California where it has leased approximately 12,000 square feet of office and manufacturing facilities on a < 10 > year lease at an annual rental of $< 73,200 >. Management believes that the Los Angeles area provides a particularly attractive location for its operations because a large number of firms offering the types of high technology-related manufacturing services which the Company will require are located there. The Company intends to subcontract most of the hardware manufacture and to concentrate primarily on material control, assembly and testing (see "MANUFACTURING").

The Company has its research and development operations located at 257 Vassar Street, Cambridge, Massachusetts, where it leases 4,700 square feet on a two year lease at an annnual rental of $32,400. The majority of the research and development team worked at MIT (see "MANAGEMENT AND KEY EMPLOYEES"). The development of the LISP Machine, its systems software and much of the applications software which the Company will use was carried out at MIT and many future developments and enhancements are expected to continue to originate from MIT (see "THE COMPANY'S PRODUCTS"). Management believes that it is of paramount importance that the Company remain at the forefront of both hardware and software technology. It considers one of the principal ways of achieving this objective is to have a continuing close relationship with the staff and researchers at MIT. This relationship is aided by locating the research center in close proximity to MIT.

3.4 BANKING

The Company maintains an account with the Security Pacific National Bank at 14th and Wilshire, Santa Monica, California, which extended to the Company a $175,000 line of credit at an interest rate 1 point over its prime rate, secured by the personal guarantees of Messrs. Adams and Noftsker. This line of credit was borrowed upon and subsequently paid off. The Company presently has a $500,000 line of credit with Bank Of The West, a member of the Banque Nationale de Paris Group. This line of credit is personally guaranteed by Messrs. Adams and Noftsker.

3.5 PROFESSIONAL ADVISORS

The Company employs the services of the following professional firms and advisers:

Investment Bankers -- Wedbush, Noble, Cooke, Inc.
615 South Flower Street,
Los Angeles, CA 90017
Tel.: 213-620-1750

Auditors -- Arthur Young & Company
Mel Masuda
515 S. Flower Street
Los Angeles, CA 90071
Tel.: 213-977-3200

Attorneys -- (a) Andrew Egendorf
Widett, Slater & Goldman, P.C.
60 State Street
Boston, MA 02109
Tel.: 617-227-7200

(b) Robert Mosher
Nossaman, Krueger and Marsh
Union Bank Square, 30th floor
Los Angeles, CA 90071
Tel.: 213-628-5221

Industrial Designers -- Emerson/Johnson/Mackay Inc.
4940 Vineland Ave.
No. Hollywood, CA
Tel.: 213-877-0423

Advertising Agency -- Michelson/Matsumoto Advertising
2029 Century Park East, Suite 1520
Los Angeles, CA 90067
Tel.: 213-557-0400